NASA NDE WORKING GROUP NEWSLETTER

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THE 10th ISSUE OF THE NNWG NEWSLETTER

NASA HQ CODE QT MESSAGE

Joseph Siedlecki, 202-358-0205, Fax 202-358-2778

NASA HQ RECENT REORGANIZATION - NASA Headquarters workforce downsizing is proceeding as planned. As you can see from the header, I have been transferred to Code QT. Preliminary discussions regarding the transfer of the NDE function are scheduled to begin shortly. I will keep you informed of the progress.

I am pleased to see that the planning for the annual NNWG Workshop is proceeding. This Workshop is scheduled to be held at the end of January at Kennedy Space Center (KSC). It will provide an excellent opportunity to review the on-going and proposed RTOP programs as well as the status of the functional transfer of NDE to a NASA Center.

NNWG HIGHLIGHTS

Yoseph Bar-Cohen, 818-354-2610 and George Baaklini 216-433-6016

NNWG TELECON - On October 31, 1995, NNWG held a NASA-wide Telecon to discuss current issues of interest to the members of the NASA NDE Working Group. Joe Siedlecki, NASA HQ, opened the Telecon and gave an update regarding the on-going reorganization at HQ. Bar-Cohen, JPL, covered suggestions for NNWG future directions, the status of this Newsletter and the on-line communication network. Topics for the upcoming 3rd NNWG Workshop were discussed in an effort to prepare

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a draft of the agenda. This Workshop will be held at NASA KSC from Jan. 30 - 31, 1996, with a tour of the Kennedy Space Center facility on Feb. 1. Ed Generazio, LaRC, covered the activity of the Code Q Committee and the plans for FY'97 Call for RTOP Proposals. Further, Rick Russell, KSC, covered the activity of the Orbiter Sub-Committee, which he recently founded. It the conclusion of the Telecon it was agreed that the NNWG directory will updated, a list of the members' participation in technical societies will be formed, a draft of the Agenda will be sent to the member sometime in November, define the vision for "NASA NDE after 1996" and modify the criteria and process of reviewing and prioritizing RTOP proposals.

NDE ELECTRONIC COMMUNICATION - Electronic communication and information interchange are quickly becoming a leading forum for technical interaction. An NDT on-line Newsgroup was recently formed as was announced in the previous issue of the NNWG Newsletter. The establishment of this forum was a tremendous step forward in the quest to improve the exchange of information and provide a platform for discussion of issues related to NDE of materials and structures. The increasing number of relevant Homepages being established on the World Wide Web is another indication of the important role that Internet is going to play in our future. But how will it affect the way we work? INSIGHT is planning to address this issue in its January 1996 publication (see further information on page 8).

ORBITER NDE SUB-COMMITTEE (ONSC)

Rick Russell, 407-861-4168

The Orbiter NDE Sub-Committee (ONSC) held a Telecon on September 11, 1995. The topics discussed were:

INFRARED THERMOGRAPHY - The infrared thermography discussion centered around the proof-of-concept instrument which is under development at the KSC instrumentation laboratory. The application of this technology for detection of corrosion under paint was discussed. KSC Vehicle Engineering presented a summary of how this technology would assist in the reduction of processing time through the quick inspection of large areas and the prevention of false indications. It was pointed out that this technology would not be limited to the Orbiter, and that it can have potential applications to other flight hardware, GSE and facility systems.

PAYLOAD BAY DOOR INSPECTION - The inspection of the payload bay doors from OV-103 (Discovery) during its upcoming down period was discussed. Modifications to the thermal protection system will necessitate its removal and may provide an opportunity to apply both shearography and thermography as potential techniques for detecting debonds and moisture entrapment.

INSPECTION OF STRUCTURES WITHOUT FASTENER REMOVAL - Recent changes to the Orbiter Fracture Control Plan have eliminated the need to develop new technologies for the inspection of Orbiter structure without fastener removal.

NNWG PERSONNEL NEWS

EDWARD GENERAZIO, NESB HEAD, RECEIVED MANAGEMENT AWARD - Ed Generazio received NASA Langley Research Center Equal Opportunity Award, September 1995, for his personal commitment and leadership in advocating the ideas of the Equal Opportunity Program at Langley Research Center. Congratulations, Ed!

Ed Generazio receiving LaRC Management Award

NASA CENTERS NEWS

ARC

John Segreto 415-604-4112

SUCCESSFUL APPLICATION OF THE REVERSE-GEOMETRY X-RAY METHOD - Recently, two prototype all-composite wind tunnel blades were removed from the 11x11 ft. Unitary Plan Wind Tunnel (WT) 3-stage compressor. These blades have seen full service for a year and half. We're happy to report the results of the NDE of these state-of-the-art composite WT compressor blades. Both blades were subjected to rigorous X-ray inspection using Digiray Corporation's Reverse Geometry X-ray™ system. Image sensitivity was such that even trowel-tool ridge patterns left behind in the resin at the bond lines between skin halves could be seen. No defects were observed other than a few small fabrication voids previously identified during acceptance NDT prior to installation in the compressor. The prevailing feeling regarding the image quality of the Digiray system was an altogether enthusiastic "thumbs up"!. This is a truly remarkable NDE technology!.

GSFC

James Chern 301-286-5836

MATERIALS BRANCH IS NOW MATERIALS ENGINEERING BRANCH - The Materials Branch of Assurance Technologies Division, Office of Flight Assurance has been reorganized, effective October 1, 1995. The Materials Branch also changed its name to the Materials Engineering Branch. Richard Marriott is the Branch Head with Jane E. Jellison and Roamer E. Predmore as Assistant Branch Heads. The Branch now consists of 5 functional groups: Materials Assurance Group (led by Mike Barthelmy), Chemical & Thermal Analysis Group (led by Alex Montoya), Mechanical Properties & Metallurgy Group (led by Mike Viens), Physics and Ceramics Group (led by Brad Parker) and Environments & Processes Group (led by John Scialdone). The basic functions of the Branch remain the same: the Branch provides a broad spectrum of analytical and support services to all Goddard flight projects. The functions of the branch include materials assurance and review, development, identification, certification, failure analysis, and nondestructive evaluation and testing of space flight hardware.

JPL

Yoseph Bar-Cohen, 818-354-2610

BENJAMIN JOFFE JOINING THE NDE GROUP - Benjamin Joffe is working with the JPL NDE Group, under the direction of Bar-Cohen. Joffe is developing devices and mechanisms that will provide low cost, high speed inspection of aerospace structures. He is a mechanical engineer with over 35 years experience in the area of electromagnetic system

and precision mechanisms design and development. He received his Ph.D. from the Latvian Academy of Sciences and has over 200 patents.

Benjamin Joffe, a new member of the JPL's NDE team.

JOINT EFFORTS WITH LaRC - On Oct. 26, JPL and LaRC held a meeting to coordinate future collaboration in NDE. The meeting focused on the JPL-led new joint RTOP that is related to measuring elastic properties of composites using ultrasonic NDE. Further, miniature NDE technologies were discussed in order to support an on-going JPL effort in the area of TeleRobotics. This effort is led by Paul Backes, JPL, who also attended the meeting.

VISIT TO CNDE AT IOWA STATE UNIVERSITY - Yoseph Bar-Cohen, NDE, and Paul Backes, TeleRobotics, visited at the CNDE of Iowa State University to discuss areas of mutual interest related to NDE and TeleRobotics. Don Thompson and Dale Chimenti, who hosted the visit, reviewed the extensive R&D activity in NDE at CNDE. Several areas are showing potential applicability for miniaturization technologies and field applications. These include: portable-bubbler for ultrasonic c-scan, air-coupled UT, and pulsed eddy-current. Other areas of interest are: determination of Probability of Detection (POD) with minimum number of tests as well as simulated NDE. Of particular interest we found the simulation of radiography where the response on the film can be predicted using the part CAD data, expected defects and the test parameters (film type, KV, mA, etc.).

JSC

Royce G. Forman, 713-483-8926

CHARLES SALKOWSKI PROMOTION AND NEW JSC REPRESENTATIVES - Charles Salkowski, the previous JSC Engineering representative to the NASA NDE Working Group, was promoted to Chief of the Manufacturing & Process Development Branch. His previous responsibilities in NDE have been transferred to Royce G. Forman and Glenn Ecord from the Materials & Failure Analysis Branch. Forman will assume Salkowski's representative position in NNWG and be responsible for continuing the NDE tasks at JSC in probability of detection (POD) of flaws and development work in NDE guidelines and methods. Forman is also co-chairman of the NASA Fracture Control Methodology Panel. Further, Forman will coordinate the common interests between the Fracture Control Panel and the NNWG. Ecord is responsible for the implementation of Fracture Control within the Engineering Directorate, and he will assume Salkowski's responsibilities for NDE application problems at JSC on the Shuttle, Payloads and the Space Station. If needed, Forman can be contacted at 713-483-8926, Ecord at 713-483-8924 or either one by FAX at 713-244-2319.

KSC

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SHEAROGRAPHY AT KSC - KSC operates an advanced shearography system that uses a krypton laser and three stressing method (thermal, pressure reduction, and acoustic) to test for debonds in composite structure. By the end of the year, KSC will receive a chamber capable of inspecting flight hardware with maximum dimensions of 52 in^2. Further, by the end of January, KSC will accept another system, which

is more portable. This new system will include vibration stressing and will have enhanced performance.

The current system was customized for inspection of the External Tank (ET) and Solid Rocket Booster (SRB) Thermal Protection System (TPS). The contractor, MSFC, and KSC have shown that shearography is a promising technique. KSC tests determined that shearography can detect a circular debond with a diameter equal in size to the thickness of the Spray-on Foam Insulation (SOFI) on the ET with a tolerance of 95 % and a confidence level of 95 %. Preliminary results of K5NA on the SRB are showing similar sensitivity, however more tests will be needed to determine specific statistical results.

KSC has performed tests on two of the Robotic Manipulator System (RMS) composite structures, which are composed of Kevlar exterior facesheet, nylon-adhesive honeycomb, and graphite-epoxy inner facesheet. No inspection technique had existed prior to the use of shearography. Using acoustic stressing shearography detected debonds as small as 0.375 inch, which is the width of the honeycomb cell. Inspection revealed five debonds on one RMS and thirteen debonds on another one. KSC is working with the manufacturer, SPAR, regarding the disposition of these results.

Future inspections are planned for various areas of the SRB and the Orbiter. Areas on the SRB include 100% of the field joints and areas of concern on the frustum and aft skirt close-outs. Areas on the Orbiter include doubler bonds and the Payload Bay Doors.

John Larson, 407-867-3423
COMPUTERIZED TOMOGRAPHY (CT) DENSITY CHARACTERIZATION OF SHUTTLE TILE MATERIAL BLOCKS - The KSC NDE laboratory has developed a method of tile material block density characterization which accomplishes 100% inspection, minimizes operator time, avoids excessive handling and produces results which surpass 95% confidence limits. Typically, 16 to 20 blocks (10 x 10 x 5 in. each.) are prepackaged with reference standards, are brought into the lab and are CT scanned in 5 mm thick slices at 5 mm increments using a cobalt source. The CT data acquisition, prior to analysis, is fully automated. Typically, the blocks require 50 hours of scan time, but require no operator intervention. Analysis of the data requires approximately 4 hours, utilizing a lab developed analysis program (TPSTAT). Comparisons of TPSTAT results with full block densities (weight measured) show a difference of only a few hundredths of a pound per cubic foot. The TPSTAT analysis program is generic enough that it can be utilized for other applications.

LaRC

Edward R. Generazio, 804-864-4970
THERMAL NDE SUPPORT TO THE U. S. ARMY MISSILE COMMAND - Quantitative NDE thermal measurements were performed on 5-inch diameter composite tubes with impact damage. A report was generated that discusses the measurement of thermal diffusivity, fiber volume fraction and damage quantification through the thickness, as well as full circumference inspection of a single tube.

AGING AIRCRAFT NDE EQUIPMENT DEMONSTRATED AT OSHKOSH FAA FLY-IN CONVENTION - LaRC NESB demonstrated their ultrasonic bond and corrosion detection system to attendees of the Oshkosh Experimental Aircraft Association Fly-In. This demonstration was done in partnership with two small aircraft service companies, Basic Aircraft Research and Miami NDT, who have been applying the instrument to aircraft in the field. In addition to the general public, the audience included FAA airworthiness specialists for General Aviation, persons from the local FAA office and FAA Headquarters.

THE LaRC AGING AIRCRAFT NDE USING ULTRASONIC BOND AND CORROSION

DETECTION SYSTEM RECEIVED FAA APPROVAL TO APPLY FOR AN AIRCRAFT REPAIR STATION AUTHORITY PERMIT - FAA approval has been granted to proceed with a formal application under FAR 145 for designating the Brookhaven Airport in Shirley, New York, as an Aircraft Repair Station with the specific authority to apply NESB's advanced ultrasonic bond and corrosion detection system to aircraft. This is a successful first step in bringing this technology a step closer to widespread usage throughout the aviation industry.

BILL WINFREE, NESB, TO PARTICIPATE IN REVIEW ON NDE TOOLS FOR AIRCRAFT - Bill Winfree participated in a review of an FAA effort to develop and apply a comprehensive set of tools to evaluate the capabilities and potential of inspection systems applicable to specific aircraft components. The evaluations will enable fair assessment of different research efforts aimed at the development of NDE systems of inspection of aging aircraft. This assessment will assist in decisions about which efforts to continue, discontinue or redirect. In August, the review was held at the Sandia National Laboratories, AANC NDI Validation Center.

TEST INTRACRANIAL PRESSURE (ICP) MONITOR AT ARC (John Cantrell and Tom Yost, NESB) - It has been proposed that space flight causes an increase in ICP, and that this increase in pressure leads to headaches and nausea discomfort for astronauts. John Cantrell and Tom Yost made critical, in-situ, and nonintrusive measurements of intercranial pressure on a cadaver that was cycled through pressure cycles. The ICP device is part of a technology transfer program being supported by NESB.

MSFC

Sam Russell 205-544-4411

EXTERNAL TANK (ET) - SUPER LIGHT WEIGHT TANK (SLWT) (Linda Clark) - A Penetrant Inspection Team consisting of engineers and technicians from MSFC's NDE Branch along with personnel from Lockheed-Martin (MSFC, Michoud Assembly Facility-MAF), worked together to address and resolve several issues/concerns of the penetrant inspection process for the SLWT. Selection of the proper penetrant for SLWT, cleaning of oxides on welds, masking of indications by wire brushing, 2195 probability of detection (POD) and lox compatibility were issues of primary interest. P6F4 was the penetrant selected to inspect 2195 parent material. The use of P6F4 presented many concerns for 2195/4043 initial and repair welds. The interpretation of penetrant results using P6F4 was greatly affected by an oxide layer produced on the weld bead surface. Lockheed-Martin and MSFC disagreed on how to effectively remove the oxide layer without compromising the results of the penetrant inspection process. Lockheed-Martin's current practice is to remove the oxide layer by wire brushing the weld bead prior to penetrant inspection without etching. MSFC was concerned that Lockheed-Martin's procedure of wire brushing without etching would result in masking of indications. A wire brush study conducted at MSFC confirmed that measurable changes in the length of penetrant indications occur with wire brushing, and that etching of wire-brushed weld surfaces is required prior to penetrant inspection. MSFC recommended that Lockheed-Martin implement this procedure permanently for SLWT welds. A penetrant comparison study was conducted at MAF by both MSFC and Lockheed-Martin personnel which resulted in the selection of a new penetrant, P135E, for the inspection of SLWT welds. P135E was selected due to its processability and productivity gains. Significant parameters which contributed to the selection of P135E include: improved washability, improved interpretation and ease of removal. A cleaner remover, 9PR50, was recommended to be used during the process and for post inspection cleaning. Use of 9PR50 was very effective in the removal of significant amounts of P135E. Several follow on tasks are

currently being worked (LOX threshold testing for P135E, 2195 POD study, etc.).

SHEAROGRAPHY (Sam Russell) - The University of Alabama at Huntsville (UAH) task titled "Methods of Video and Shearography Inspection" was completed and the final report is available. This report details inspections conducted on composite components such as fuel tanks, fuel feedlines, fairings, simulated rocket motor cases, fairings, and thermal protection coatings. Two new efforts were initiated with UAH. The first is to develop methods of precisely controlling the heat input into a structure under investigation with thermal excitation shearography. Thermocouples will sense and report to a controller computer the temperature on the structure. The controller will adjust the lamp or convective heaters to maintain a standard test. The second effort will develop tests for bondlines with thin liners inside confined structures such as tanks or feedlines. Preliminary tests on composite feedlines have shown a slight damage may cause leakage. Hence, metal or polymer liners may in some case be needed. These tasks should be completed in FY96.

ACOUSTIC EMISSION USED ON AXAF HARDWARE (Chuck Wilkerson) - A recent test of the High Resolution Mirror Assembly joint (HRMA) used a Physical Acoustics Spartan AE system to locate acoustic events during the loading of the joint. In this first test no anomalous events were detected.

REUSABLE LAUNCH VEHICLE (Chuck Wilkerson) - The various RLV programs have brought considerable work to MSFC, beginning with addressing inspection and vehicle health management issues at the initial stages of the design and continuing with the inspection of RLV hardware. Composite feedlines, fuel tanks and honeycomb intertanks are among the hardware items that have or will be inspected at MSFC. The techniques used vary widely. Acoustic emission will be one of the methods used to monitor a cryotank during upcoming testing. Ultrasound, thermography and shearography will be used to inspect the composite/honeycomb intertank segments being fabricated at MSFC. Ultrasound and radiography were recently used to inspect a composite feedline and the metal to composite joints in that feedline.

INDUSTRY AND ACADEMIA NEWS

Diffracto Limited

David Willie, 519-945-6373, Diffracto@Netcore.ca

DETECTION OF ALUMINUM SKIN CORROSION USING D-SIGHT™ - Surface and near-surface flaws, such as corrosion in metals and impact damage in composites, are causing a local surface deformation. Diffracto Limited developed an NDE method, so-called D-Sight, that enhances the appearance of this deformation to increase its visibility. The D-Sight effect was discovered by Diffracto researchers in 1984. A D-Sight test system consists of a CCD camera, a white light source mounted slightly above the camera lens, and a retro-reflective screen. This screen is made of a reflective micro-bead layer and is the most important element of the D-Sight system. While it returns most of the light in the same direction of the incidence, a slight amount of light is dispersed due to the characteristics of the screen. When a surface is illuminated by the light source, local surface curvatures act to focus or disperse the light onto the retro-reflective screen.
A light pattern is formed on the screen and is reflected back to the source with a slight dispersion. This path of the light backlights the part surface and enhances the scattering effect of surface deformations. By viewing the surface slightly off-axis from the light source a unique pattern appears near local surface deformations. This pattern consists of bright and dark gray scale variations, where higher curvatures appear more intense due to the effect of focusing and diffusing the light. To obtain a sufficient level of diffused light the surface must be reflective, otherwise a

thin layer of liquid needs to be formed on the surface to increase its reflectivity.

The use of D-Sight for corrosion evaluation is currently being explored under a collaborative agreement between the National Research Council of Canada, Institute for Aerospace Research (NRC/IAR), and Diffracto. Extensive research had been carried on aircraft fuselage lap-joints to determine the level of surface displacement that is caused by interlayer corrosion. A finite element analysis was conducted on typical Boeing and McDonnell Douglas fuselage lap-joints with various levels of interlayer corrosion damage.

D-Sight unit in operation

INSIGHT

David Gilbert, 100565.3235@compuserve.com
INSIGHT - Nondestructive Testing and Condition Monitoring (The Journal of The British Institute of Nondestructive Testing) is planning a feature on "NDT and the Internet" for its January 1996 issue. Articles are requested for publication, ranging from brief items (300+ words), to in-depth papers on the current status and future impact (max. 3000 words, plus pix). A list of relevant sites will be included and it is hoped to make this as up-to-date as possible. Naturally, this is a useful opportunity to encourage those not yet using the Internet to begin to do so, so basic introductory articles are also welcome. The deadline for contributions is 17 November 1995, which is realized to be short notice. However, if you have something to say - even controversial subjects would be considered - please e-mail your article to 100565.3235@compuserve.com. Alternatively, post to: INSIGHT, 1 Spencer Parade, Northampton NN1 5AA, UK.

Johns Hopkins University

Boro Djordjevic, 410-516-6115, boro@jhu.edu
CENTER FOR NDE (CNDE) AT JHU - CNDE at The Johns Hopkins University is a multi-disciplinary organization encompassing activities in research, development and application of nondestructive evaluation technologies. CNDE is supported by industrial members and is sponsored by G. W. C. Whiting School of Engineering.

In addition to the support received from its sponsoring members, the CNDE benefits from strong collaborative ties with government, academic facilities, and with private industrial concerns of all sizes. Current efforts are directed at developing and optimizing techniques which are capable of monitoring and controlling materials production processes, materials stability during transport or storage and the amount and rate of degradation during in-service life. The CNDE NDE tools development are focused on advanced sensors, remote sensing, in-situ sensors, along with signal processing and data analysis on material processing and properties.

CNDE activities extend to undergraduate and graduate student education and a diversified list of research trust areas including laser ultrasonic, optical NDE, thermal testing, X-ray materials characterization, composite and ceramic materials characterization. Detail information on the current program activities is provided in the "CNDE Annual Report" available on request.

Ohio State University

Stan Rokhlin, (614) 292-7823
rokhlin.2@osu.edu
NDE PROGRAMS AT THE DEPARTMENT OF INDUSTRIAL, WELDING AND SYSTEMS ENGINEERING - Ohio State

University has received a $290,000 grant for equipment to develop a microfocal radiographic and tomographic laboratory to study microdamage in materials under mechanical loading. Other applications include the study of joining processes in real time. This grant is part of a one-million-dollar grant received recently by a consortium of Ohio universities including the University of Dayton, OSU, the University of Cincinnati, and Cleveland State University. The most recent research program sponsored by NASA-Lewis Research Center includes the development of methods for determination of residual stresses in composites. We have been able to develop a model and experimental technique for stress determination, which includes the effects of inhomogeneities in the material and nonhomogeneous stress distribution. Among other accomplishments is the development of methods for interface characterization in high-temperature composites, including the determination of the effective elastic moduli and characterization of fatigue damage of the interface. Other efforts include work in quantitative characterization of adhesive joints and plasma-sprayed coatings.

PRI Instrumentation, Inc.

Sandra Simms, 310-791-1774, physres@earthlink.net

MAGNETO-OPTICS IMAGER (MOI) A MEANS FOR VISUALIZATION OF EDDY CURRENT RESPONSE - The Magneto-Optic Imager (MOI) combines planar eddy current and magneto optics imaging. This instrument represents a new technology of inspecting metallic structures for surface and subsurface cracks and corrosion. The MOI is able to image through paint and other surface coverings in real time and to display the results on a heads up display and/or a monitor. MOI is a hand-held, portable instrument that requires minimal training and its capability greatly increases the speed and reliability of inspection. The MOI is being used extensively for aircraft inspection by airlines, maintenance facilities and the military. Other industrial applications are currently being explored.

A view of the MOI in operation

Sandia National Laboratories

Julie Clausen, 505-844-0948

FAA CENTER FOR NDE - Sandia National Laboratories Airworthiness Assurance Nondestructive Inspection Validation Center (AANC) was created in August 1991 (under the name Aging Aircraft NDI Validation Center) to enhance the structural Inspection of aging civilian aircraft. The center arose out of the Aviation Safety Act of 1988, passed by Congress after the midair structural failure of an Aloha Airlines Boeing 737. Sandia's role has since been expanded to other areas covering an aircraft's overall safety system design such as fire protection, information system management, and accident investigation support. Sandia National Laboratories is a multiprogram Department of Energy laboratory, operated by a subsidiary of Lockheed Martin Corp. Its facilities are located in Albuquerque, NM, and Livermore, California. Sandia has major R&D responsibilities in national defense, energy, environmental technologies, and economic competitiveness.

Wesdyne International

Frank J. Dodd 800-493-7396

DEVELOPED LOW-COST MINIATURE DATA ACQUISITION CARD - Recently, Wysdyne has developed a miniature data acquisition card to address the need for low-cost low-mass ultrasonic inspection capabilities. This type 2 PC (formerly PCMCIA) card was introduced at the ASNT Fall Conference. The card can be installed on a laptop computer with a small ultrasonic pulser receiver and with an appropriate software it forms a complete UT data acquisition and imaging system. This card includes a motion control (encoder) interface, 40 MHz - 8 bit A/D converter, signal processor and 4 Kbytes of high speed memory. All the data acquisition parameters and the real time display are controlled via PC-Windows base software. The full system is battery operated and it provides a full waveform capture UT imaging system.

COMING EVENTS

- Dec. 4-8, 1995 - JANNAF Propellant Meeting, Joint Subcommittees Meeting including NDE - Tampa, FL. CPIA 410-992-7304.
- Dec. 8-13, 1996 - 14th World Conference on NDT - New Delhi, India, Baldev Raj, 04117-40301
- Jan. 30-31, 1996 - 3nd NNWG Workshop - KSC, Florida, Yoseph Bar-Cohen 818-354-2610.
- Feb. 20 - 23, 1995 - Structural Materials Technology NDE Conference, San Diego, CA, Phil Stolarski, 916-227-7242.
- Mar. 18-22, 1995 - ASNT Spring Conference - Norfolk, VA, ASNT Headquarters, 614-274-6004.

NASA NDE Working Group (NNWG) Newsletter

Editor: Yoseph Bar-Cohen, JPL

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